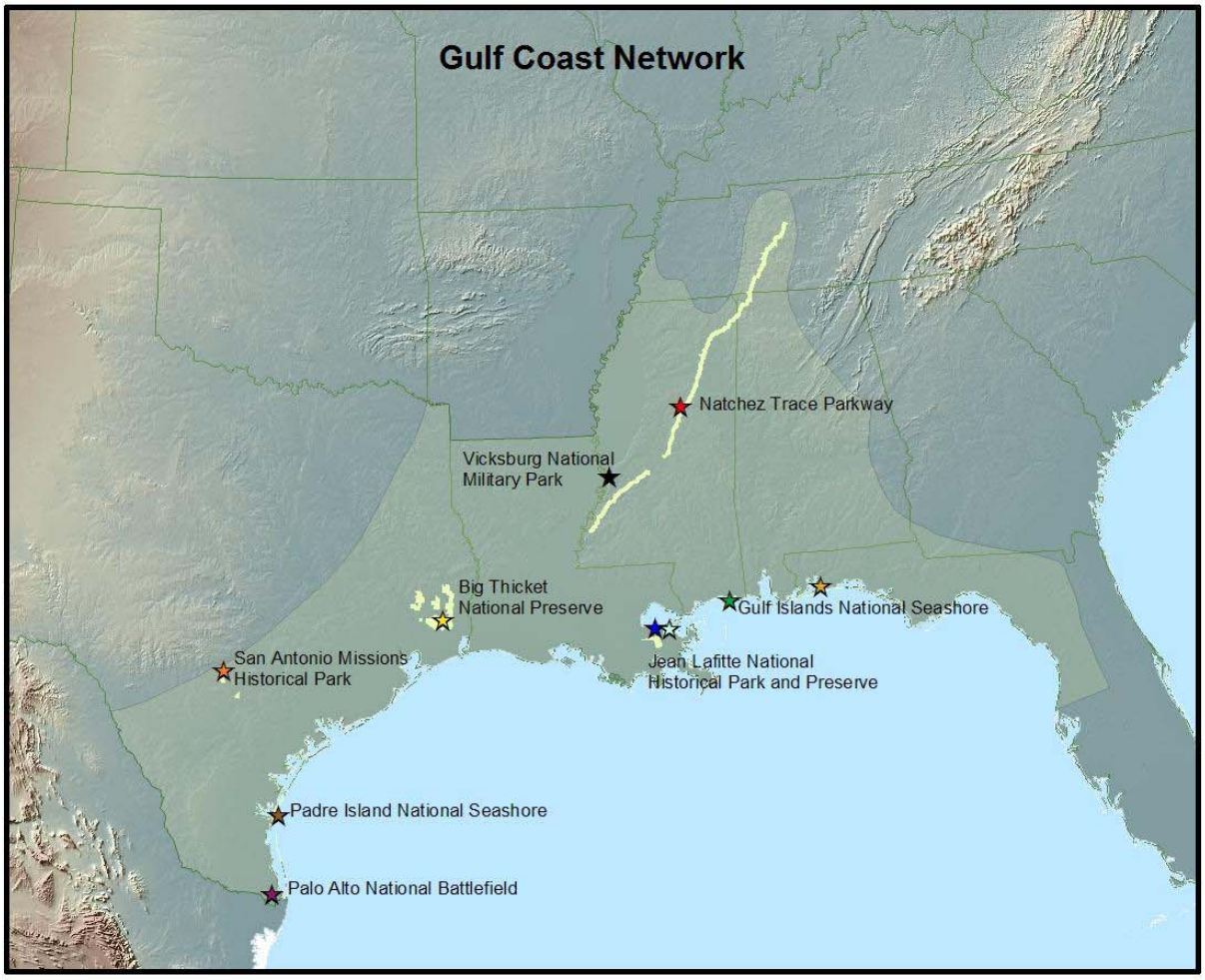
Natural Resource Summary for
Palo Alto Battlefield National Historic Site (PAAL)

FINAL REPORT

November 2004



Prepared by

Robert J. Cooper
Sandra B. Cederbaum
and
Jill J. Gannon

Warnell School of Forest Resources
University of Georgia
Athens, GA

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EXECUTIVE SUMMARY

Palo Alto Battlefield National Historic Site (PAAL) exists in a region known as the Matamoran district of the Tamaulipan biotic province, which has been described as a 'unique blend of western desert, northern, coastal and tropical affinities.' This park is located 10 miles north of the Rio Grande River in the southern tip of Texas and preserves the 3,400-acre site of the first major battle of the U.S.-Mexican War.

Three surveys have been conducted on the park's vegetative habitat and found that despite the general low relief of the entire park (9.7-20.9 feet), slight changes in elevation resulted in a variation of the vegetation. These surveys also characterized the habitat types, listed possible threatened or endangered species that could exist in the park and discussed the effects of past landuses on the vegetation communities. The most recent survey created an inventory of vascular plants that documented 243 species from 66 families on the park. No threatened or endangered species were found although one species, reflexed airplant (*Tillandsia baileyi)*, was on the Texas Organization for Endangered Species watch list.

Three surveys of the general vertebrate fauna have occurred since the park's expansion in 1992. The methodology ranged from observational to standardized surveys and not all surveys sampled each of the vertebrate groups. In addition to these general surveys, there also have been surveys conducted on specific groups or species.

A total of 18 mammal species have been observed within the park and surrounding areas. One of these species, the ocelot, is a Federal and Texas state listed endangered species and has been known to occur along the drainage ditches just to the north of the battlefield. A sampling effort occurred about 10 years ago to see if ocelots or jaguarundis existed in the park but none were detected. Although the latest survey attempted to detail the bat community in PAAL only one species was detected likely due to the three-year drought and the resulting lack of open water. Based on distribution maps an additional nine bat species could occupy the park.

Sixteen reptile species, including four species of lizards, two turtles, and 10 species of snakes, and six amphibians, all anurans, were confirmed in PAAL during the latest inventory of the park's herpetofauna. One state threatened (Texas tortoise) and two state endangered (Texas horned lizard and Texas indigo snake) species were detected during this study. A number of amphibian species found within the county have not been detected in the park, likely due to the lack of available freshwater. Additional anurans may be detected in future studies if surveys can be conducted during periods of increased rainfall. No salamanders or newts were documented during the sampling likely due to the dry weather that occurred when potential habitat was investigated. Two state endangered species, the black spotted newt and the Rio Grande siren could possibly exist within the park if rainfall levels increased and created standing water in the park for more than a day or two.

A total of 110 species of birds have been detected in the park. Decreased species counts have been noted during years of drought due in large part to the reduction in standing water and associated reductions in wetland species. The Aplomado Falcon, a Federal and Texas state listed endangered species that was formerly thought to be extirpated, was recently detected in the

park. Seven other avian species detected in the park, Brownsville Common Yellowthroat, Ferruginous Hawk, Loggerhead Shrike, Reddish Egret, Texas Botteri's Sparrow, Texas Olive Sparrow, and the White-faced Ibis, are Federal Species of Concern. Two additional species, White-tailed Hawk and Wood Stork, are also being monitored by Texas Parks and Wildlife.

Very little is known about fish populations in PAAL. Only one survey has been able to collect any data on fish populations in the park. During this survey 10 species were identified (9 euryhaline and 1 freshwater) in the tank north of Arista's Hill. No Federal or Texas state listed species are known to exist in PAAL. During periods of heavy rain, fish have also been found washed into the park. No identification of the species has been possible due to the rapid evaporation of standing water, which leaves them exposed to predators. Re-establishment of the deeper resacas during these floods is also possible.

Current information on the park's invertebrate community is extremely limited. There have been no surveys on the invertebrates of the park. Species existing in the park have been discussed superficially and most often as general groups of species (e.g., grasshoppers, dragonflies, and butterflies), but no detailed list of invertebrates exists and there is no knowledge of threatened or endangered species in PAAL.

The park lies in the Rio Grande delta, one of three large deltas resulting from deposits left by the melt waters of late Pleistocene glaciers. The current geology of the park is described as relict or a periodically active environment since hurricanes are the only force that brings new deposits to the site; its sediments are referred to as Holocene and Modern fluvial-deltaic. Seven soil types were found in PAAL and can be classified into three groups based on salinity and drainage, salt prairie (Lomalta Clay, Benito Clay, Latina Sandy Clay, Sejita Silty Clay Loam), levee (Laredo Silty Clay Loam), and transition soils (Chargo Silty Clay, Laredo Silty Clay Loam, Saline). Salt prairie soils are highly saline, have a generally flat or concave surface, retain water well, and are primarily found in the remnant meanders and the flood plains. Levee soils are found along the edges of the remnant meanders, are higher than the surrounding floodplains, have better drainage, and lower salinity levels. Vegetation grows well in these areas. Transition soils also exist next to remnant meanders but, as the name implies, the salinity levels, elevation, and water retention is somewhere between salt prairie soils and levee soils. Lomalta Clay is the predominant soil series in PAAL.

There have been no major hydrologic surveys conducted on the site although some preliminary hydrology monitoring was conducted during recent resaca restoration projects. The groundwater of PAAL and the surrounding areas is poor quality and unproductive. Much of the groundwater in the area had high dissolved sodium, chloride, sulfate, boron, and nitrate and therefore was unsuitable for irrigation. Salinity levels under the battlefield were classified as moderately saline to very saline. Natural wetlands occur in the area in old meanders or resacas of the Rio Grande although they vary in the persistence of water. Lacking streams, much of the surface water travels across PAAL in sheets. Surface water in much of the Lower Rio Grande Valley (LRGV) is transported through man-made ditches such as the one that forms the northern boundary to the park. Because salt prairie habitat dominated the site and row crop agriculture was not successful, PAAL is generally free of scars caused by major drainage and irrigation ditches. There are four ponds and multiple old resaca beds at the park that vary in ability to retain water due in part to

human influences such as installation of cattle tanks and drainage. All areas within the park are above the tidal influence and are only occasionally flooded by saltwater during tropical storms or hurricanes. Periodic floods have been eliminated due to the dams and drainage projects in the area; where these depressions used to hold flood water from the river they now only retain water for short periods after heavy rains.

There has been no systematic collection of air quality data within the park and no plans to begin collection on site. No large emission sources are located near the park and air quality is generally very good, although burning of nearby agricultural sites does occasionally cause high concentrations of particulate matter and smoke. National Atmospheric Deposition Program/National Trends Network sites around the state have documented a slight decrease in wet sulfate and wet nitrate concentration, but no trend in wet ammonium concentration and deposition or in wet sulfate and wet nitrate deposition.

Three general habitat types or zones have been described in PAAL: Brushland, Salt Prairie, and Wetlands. Brushland habitat covers about 23% of the park and exists primarily on the area adjacent to the meandering resacas. The area adjacent to the meandering resacas is slightly higher in elevation, has better drainage, and allows soils to have a lower salinity than the neighboring salt prairie; therefore, it supports a different plant community. These areas exist for the most part from the southwest corner along the western side and curve along the northern boundary of the park. These elevated areas are dominated by honey mesquite, spiny hackberry, Texas ebony, and common anaqua in the overstory, and jujube or lotebush, colima lime pricklyash, and Lindheirmer's prickly pear as the understory. Salt prairie habitat is the largest system on the PAAL covering 75% of the land area. This vegetation type exists in areas of low elevation where there is increased salt build-up due to poor drainage. Within the salt prairies, natural depressions, which once were frequently flooded, may now be dry most of the year due to excavation of cattle tanks and disruption of the resacas. It is likely that this vegetation type has increased over the years due to the erosion and infill of resacas. Within the gulf cord grass (*S. spartinae*)-dominated salt prairie are patches slightly lower in elevation in which concentrated salt levels create what is known as Borrichia or salt flats, which support primarily sea oxeye (*B. frutescens*) and succulents among the bare patches of soil. Wetlands consist of about 2% of the total area in the park and are made up primarily of abandoned channels and tributaries of the Rio Grande as well as man-made cattle tanks. The former channels of the Rio Grande were naturally cut off from the river as it shifted over time, creating oxbow lakes (i.e., resacas). Many resacas filled with sediment overtime from erosion and now support wetland species.

The park currently contends with two major management issues, which are often interconnected: exotic species and adjacent land-use impacts. Although PAAL has largely escaped the dramatic alterations seen in much of the LRGV due to its high salinity soils, the area does show effects from previous landuses. The vegetation has changed across the park, due to previous modifications to the landscape including clearing of brushland and attempts to introduce non-native plants for grazing. Erosion resulting from the agricultural activities within the park has dramatically increased the speed by which the resacas filled with sediment, which resulted in a change in vegetation. Some alterations have reduced flooding to an infrequent occurrence limited to rainwater, so that it currently does not accurately reflect the historic scene.

Additionally, there are multiple non-native species that have been introduced to the area, including feral pig, nilgai, Norway rat, black rat, and European house sparrow and 20 plant species, which compete with the native community for resources in the park. Lastly, if Brownsville's rapid growth rate continues PAAL will become an urban park in the future, with increasing management problems due to human-wildlife interaction and landuse issues from outside the park.

Figure 1. Location and extent of the PAAL, one of eight parks in the Gulf Coast Network.

RESEARCH REVIEWS

BIOLOGICAL COMMUNITIES

VEGETATION

General surveys, studies

Palo Alto Battlefield National Historic Site (PAAL) exists in a region known as the Matamoran district of the Tamaulipan biotic province, which Farmer (1992) described as a 'unique blend of western desert, northern, coastal and tropical affinities.' Three biological surveys have been conducted which examine vegetative habitat existing in PAAL. These surveys found that despite the general low relief of the entire park (9.7-20.9 feet), slight changes in elevation resulted in variation of the vegetation.

The first survey, conducted by Farmer (1992), generally discussed the habitat types found in the park and a few of the species associated with these habitats. He also listed possible endangered or threatened species that could exist within the park due to range and habitat types.

Richard and Richardson (1993) conducted the second park survey and expanded upon the list of flora species for each habitat. They characterized the vegetation into eight types, Tamaulipan Brush, Coastal Prairie, Sacatal, Borrichia Prairie, Mesquital, Huisachal, Wetlands/Tanks, and Cleared Land, and documented 142 plant species within these communities. Tamaulipan Brush occurs on areas of the highest elevation and therefore the least saline soils and is estimated to cover 13% of the park. Although the vast areas that were once brush communities have been cleared by past landuses, those areas in the park still in brush are thought to be very similar to the vegetation found during 1846 due to the thorns that limited cattle access. It was likely that any spot over 15 feet in elevation supported a brush community. Richard and Richardson (1993) identified 80 species in this habitat, but did not locate a generally common species found in Tamaulipan Brush, common anaqua (*Ehretia anacua*). Coastal Prairie and Sacatal habitats occupy 10% and 40% of the park, respectively, and are found in similar low-lying, high salinity locations, but appear to be separated by soil type. Much of the Coastal Prairie exists adjacent to Sacatal on the sites of old resaca beds (i.e., oxbow lakes or resacas as they are locally known) that have filled in over time. Sacatal consists all but entirely of *Spartina spartinae* with some *Borrichia frutescens* in areas and exists on heavy clay soil. Sacatal generally follows the old resaca in the southern portions of the park and forms a large prairie in the east. Coastal Prairie occupies light, powdery soil and is slightly higher in elevation than Sacatal. Increased acreage of Coastal Prairie likely occurred as it expanded to cover old resaca beds that filled in due to erosion, but it is probable that the vegetation within is similar to that of 1846. Areas of bare earth exist in this habitat due in part to the high salt content of the soil. Borrichia Prairie exists in 7% of the park, which were previously occupied by old resacas or ponds, but were filled in due to erosion from past land practices. Vegetation in this habitat is almost exclusively *B. frutescens*. About 9% of the park, which historically was Tamaulipan Brush, now has stands of mesquite forest. In general, each stand has an even-age mesquite canopy with a grass understory. It is thought that these stands are the regrowth of the brush that was allowed to grow for shelter and food for cattle. A rather limited habitat type (1%), the Huisachal, exists on two long strips in the northern portion of the park and contains nearly pure stands of *Acacia farnesiana* in areas of reduced soil salinity. The northern most strip follows the canal that forms the northern border. It

is thought that the underground drainage into the canal has reduced water content and therefore salinity of the surrounding soil. Natural wetlands currently exist in the southwestern part of the site although many remain dry except during periods of rain. Tanks were excavated in areas of natural drainage throughout the park to provide water sources for cattle. Fifteen plant species were recorded in the wetland areas. Areas of cleared land make up 19% of the park and were primarily Tamaulipan Brush. These areas are in various stages of regrowth and contain a variety of species but no dominant indicator species. No endangered or threatened species or Species of Concern (SOC) were documented.

Despite the existence of these two surveys, no complete inventory list existed and little was known about the plant diversity in PAAL. The first comprehensive inventory of the vascular plants of the PAAL was conducted by Lonard et al. (2004). By using their previous collections and field surveys, they found 243 species from 66 families in four distinctive plant communities, Resaca and tanks (RT), salt flats (SF), brush-grasslands (BG), and coastal marshes (CM). Natural plant communities were based on vegetation zones identified in Lonard et al (1991), which also gave a good overview of vegetation studies that have occurred in the Lower Rio Grande Valley (LRGV). Within the natural community types, 61 species were found in RT, 84 species in BG, 18 species in SF, and 13 species in CM. Twenty species of the 136 species found in the disturbed areas of the park were introduced and several of these are considered potentially invasive.

Lonard et al. (2004) found that no threatened or endangered species were recorded although one species, *Tillandsia baileyi*, was on the Texas Organization for Endangered Species watch list. Farmer (1992) named an additional 8 species found in Cameron County that could exist in the park. Six of theses species were candidates for Federal listing and two were considered globally and/or state imperiled by the Texas Natural Heritage Program (a Texas Parks and Wildlife Department program which has since been dissolved), although none were detected during the 2004 inventory (Farmer 1992; Lonard et al. 2004).

Experts: R. Lonard (UT Brownsville; retired), A. Richardson (UT Pan Am), N. Richard (UT Pan Am: retired)

FAUNA

Due to the convergence of multiple vegetation zones within the LRGV, a wide variety of fauna have been recorded. Farmer (1992) estimated about 700 vertebrate species have been found in the region, with a number of neotropical species reaching their northern limits in the LRGV. Sixty-seven of these species were listed as Texas state or Federally endangered or threatened. Many of these listed species depend on two of the habitat types found in PAAL, brushland and salt prairie. Three surveys of the general vertebrate fauna have occurred since the park's expansion in 1992, from 50 acres to its current size of 3,400 acres. The methodology ranged from observational to standardized surveys and not all surveys sampled each of the vertebrate groups. Farmer (1992) provided a general description of the habitat types and associated species that might be found, as well as a few specific observations, but primarily focused on the possible

endangered or threatened species that could exist within the park due to range, habitat type, and local sightings. Richard and Richardson (1993) performed a coarse inventory of the fauna of PAAL through observation. Although the data collection was not structured or duplicative it does provide some information on the species found within the park. Building upon the previous surveys, Hayes (2004) used standardized data collection methods to create annotated lists of documented species existing in PAAL, and also provided conservation management recommendations. In addition to these general surveys, there also have been surveys conducted on specific groups or species, described below.

Mammals

Data on mammal populations in PAAL have been mainly documented in three papers (Farmer 1992; Hayes 2004; Richard & Richardson 1993). During the final survey, Hayes (2004) created an annotated list of all three surveys documenting a total of 18 species observed within the park and surrounding areas. One of these species, the ocelot (*Felis pardalis*), is a Federal and Texas state listed endangered species and is known to occur along the drainage ditches just to the north of the battlefield (Farmer 1992; Hayes 2004). Farmer lists three additional Texas state or Federal listed species that could potentially exist in PAAL, but were not found during any of the surveys. Four introduced species, feral pig (*Sus scrofa*), nilgai (*Boselophus tragocamelus*), Norway rat (*Rattus norvegicus*) and black rat (*Rattus rattus*), are found in the park (Hayes 2004). Only one previously detected species, nine-banded armadillo (*Dasypus novemcinctus mexicanus*), was not found on the latest survey. Hayes also attempted to survey the bat community in PAAL. The three-year drought and the resulting lack of open water likely affected the density and species richness of bat species detected in the park. Only one species was detected during surveys, plus an additional nine species could occupy the park based on distribution maps (Hayes 2004).

In addition to these general surveys, a coordinated effort by the National Park Service (NPS) and the U.S. Fish and Wildlife Service (USFWS) attempted to sample the park for ocelots and jaguarundis (*felis yagouaroundi cacomitli*). That trapping captured bobcat (*Lynx rufus*) and a number of non-feline species, but no ocelots or jaguarundis (D. Murphy, personal communication, 11 March 2004; Laack 1994; Palo Alto Battlefield National Historic Site 1994b). Ancillary data was also collected during an amphibian survey conducted by Judd and McNeely (2002) where pitfall containers also captured a few species of small mammals.

Experts: Thomas Hayes (Accipiter Biological Consultants), Linda Laack (Laguna Atascosa National Wildlife Refuge), D. Blankenship

Reptiles

Three reptile surveys have been conducted in PAAL. In his survey of the park's natural resources Farmer (1992) noted that two species, the Texas tortoise (*Gopheras berlandieri*) and the Texas horned lizard (*Phrynosoma cornutum*) had been detected by National Audubon Society members during the past year. Richard and Richardson (1993) expanded this list during

their general biological inventory to 15 species of reptiles (four turtles, five lizards, and six snakes). Three of these species, the Texas tortoise, Texas indigo snake (*Drymarchon corais erebennus*), and the Texas horned lizard were on the Texas state threatened list; the Texas tortoise was also Federally threatened and the Texas horned lizard was a candidate for Federal listing. In addition to these species, Farmer (1992) also listed three additional Texas state listed species, black-striped snake (*Coniophanes imperialis*), speckled racer (*Drymobius margaritiferus*), and northern cat-eye snake (*Leptodeira septentrionalis*), which based on range could be found in PAAL. During 2002 and 2003 the Texas Nature Conservancy conducted an inventory of reptiles and amphibians in PAAL (Duran 2004). Multiple traps (minnow traps, hoop traps, and two types of drift fence arrangements with pitfall traps), surveys (visual, auditory, and road), as well as coverboards were used to sample amphibian and reptile populations. Sixteen reptile species, including four species of lizards, two turtles, and 10 species of snakes were confirmed in PAAL during this inventory. One species included in the annotated list, the yellow mud turtle (*Kinosternon flavescens*), was not found during this sampling effort but had been trapped in the park in a previous amphibian study (Duran 2004; Judd & McNeely 2002). Duran (2004) also described a study conducted by Abell et al. (2000) that included herpetological transect surveys in the park. In addition to those species that were documented through sampling, Duran (2004) also listed possible species that could occur in the area based on ranges and documented sightings and commented on the probability they exist within the park. One Texas state threatened (Texas tortoise) and two state endangered (Texas horned lizard and Texas indigo snake) species were detected during this study.

In addition to these general surveys, Mahr (1999), described the occurrence of a dead eastern coral snake (*Micrurus fulvius fulvius*) found along FM 511, Texas. They are thought to be an oddity for the area but obviously do exist (D. Murphy, personal communication, 11 March 2004).

Experts: C.M. Duran (TNC), N. Richard (UT Brownsville; retired), other possible sources: F. Zaidan (UT Pan Am), E. Pianka (UT Austin), P. Burchfield (Gladys Porter Zoo)

Amphibians

Farmer, Richard and Richardson, Judd and McNeely, and Duran conducted surveys of the amphibians in PAAL (Duran 2004; Farmer 1992; Judd & McNeely 2002; Richard & Richardson 1993). Six species of frogs and toads were located within the park during Richard and Richardson's inventory. Most of these species were found in the resacas and tanks but two were found within the woodlands a good distance from standing water. Farmer (1992) listed four species that were either Texas state listed or candidates for Federal listing that could be found on the site, but no Texas state or Federally listed species were detected during the inventory. Farmer noted the periodic drying of wetlands in the park should be beneficial to several amphibian species as it would preclude the inclusion of larger predatory fish. During a year-long study by Judd and McNeely (2002) only one amphibian species was documented. The lack of water in the resacas and the harsh saline environment of the cordgrass and flats were named as possible reasons for the low sample numbers. Judd and McNeely (2002) also listed possible species that could exist within the park, including five Texas state threatened species. In the

draft report of the 2002-2003 study, Duran (2004) documented six species of amphibians within the park. A number of species found within the county were not detected in the park, likely due to the lack of available freshwater. Additional anurans may be detected in future studies if surveys can be conducted during periods of increased rainfall. No salamanders or newts were documented during the sampling likely due to the dry weather that occurred when potential habitat was investigated. Duran (2004) also discussed which amphibian species, based on ranges and documented sightings, could occur in the area and commented on the probability they exist within the park. Two Texas state endangered species, the black spotted newt (*Notophthalmus meridionalis*) and the Rio Grande siren (*Siren intermedia texana*) could possibly exist within the park if rainfall levels increased and created standing water in the park for more than a day or two.

During a 1999 investigation of fish populations in a resaca in the park, the resaca was listed as ideal habitat for black spotted newts and the Rio Grande siren, both of which were listed as rare and threatened (McNeely 1999).

Experts: C.M. Duran (TNC), N. Richard (UT Brownsville; retired), other possible sources: F. Zaidan (UT Pan Am), P. Burchfield (Gladys Porter Zoo)

Birds

A total of 110 species of birds have been detected on the three natural resource surveys (Farmer 1992; Hayes 2004; Richard & Richardson 1993). In addition to documenting 84 avian species, Richard and Richardson (1993) provided observational data on the habitats as well as important predators and prey for select species. The total of 68 species detected by Hayes (2004) was markedly lower than that of Richard and Richardson (1993), 9 years earlier. Most notable was the decrease in wetland species detected during 2002, likely due to the reduction in standing water caused by the three-year drought and the inaccessibility during the first portion of the survey to the eastern half of the site that had the only permanent standing water in the park. An Aplomado Falcon (*Falcon femoralis*), a Federal and Texas state listed endangered species that was formerly thought to be extirpated (Richard & Richardson 1993), was detected in the park during the latest survey. Seven other avian species from the annotated list have been included on the Federal SOC list. The SOC are the Brownsville Common Yellowthroat (*Geothlypis trichas insperata*), Ferruginous Hawk (*Buteo regalis*), Loggerhead Shrike (*Lanius ludovicianus*), Reddish Egret (*Egretta rufescens*), Texas Botteri's Sparrow (*Aimophila botterii texana*), Texas Olive Sparrow (*Arremonops rufivirgatus rufivirgatus*), and the White-faced Ibis (*Plegadis chihi*). Two additional species, White-tailed Hawk (*Buteo albicaudatus*) and Wood Stork (*Mycteria americana*), are being monitored by Texas Parks and Wildlife. In addition to these species, Farmer (1992) listed another 11 Texas state or Federally listed species and four Federal candidate species that could potentially be found within the park. One introduced species, European House Sparrow (*Passer domesticus*), was detected during the latest survey. Hayes (2004) found point counts and general audio and visual observation the most effective methods of sampling as the area is generally too windy for mist net sampling. In addition to the annotated list created from the three studies, Hayes (2004) listed 18 species, which although they have not

yet been detected, should be found in the park due to their respective ranges and availability of suitable habitat.

A nesting platform was erected in PAAL for the endangered Aplomado Falcon during the late 1990's. Although there have been no known pairs residing within the park, Jessie Brown of the Peregrine Fund has observed six pair in the area (D. Murphy, personal communication, 11 March 2004).

Experts: Hayes, Jessie Brown (AP falcon; Peregrine Fund), other possible sources: T. Brush (UT Pan Am), C. Shackelford (TX Parks & Wildlife)

Fish

Very little is known about fish populations in PAAL. During Richard and Richardson's (1993) biological inventory, 10 species were identified (9 euryhaline and 1 freshwater) in the tank north of Arista's Hill. Hayes (2004) also attempted to quantify species richness and abundance of fish in PAAL but due to a long-term drought, only one area on the site had water and this area had receded beyond the capacity for fish. Hayes (2004) reported that this pond is the only permanent water in the park and is maintained by pumping water in from the northern boundary canal. Richard and Richardson's account remains the only list of species detected in the park. No Federal or Texas state listed species are known to exist in PAAL (Hayes 2004).

Sanches pond and a shallow resaca in the park were seined during a one-day effort in 1999 to examine the existing fish populations. No fish were detected in the resaca, likely due to the lack of inflow from adjacent waterways and the total dependence on rainfall and drainage for its water source (McNeely 1999).

During periods of heavy rain, fish have been found washed into the park. No identification of the species has been possible due to the rapid evaporation of standing water, which leaves them exposed to predators. Re-establishment of the deeper resacas during these floods is also possible (P. Pappas, personal communication, May 2004)

Experts: D. McNeely (Langston University), N. Richard (UT Brownsville; retired), other possible sources: R. Edwards (UT Pan Am)

Invertebrates

Current information on the park's invertebrate community is extremely limited. Richard and Richardson (1993) list briefly a few general groups of insects detected during their inventory of the halophytic habitats of the park, such as grasshoppers, dragonflies, butterflies, paper wasps, among other insects. Fiddler crabs (*Uca subcylindrica*), snails, and general isopods were the only aquatic invertebrates mentioned. During an amphibian survey in PAAL, Judd and McNeely (2002) captured invertebrates, including fiddler crabs, scorpions (order Scorpionida) and spiders

(family Salticidae). No detailed list of invertebrates exists and there is no mention of threatened or endangered species for PAAL.

Experts: other possible sources: B. Henry (aquatic insects, UT Pan Am), G. Lopez (UT Brownsville), G. McClain (UT Brownsville; retired)

THREATENED AND ENDANGERED SPECIES

A number of Federal and Texas State listed threatened or endangered species have been documented or have ranges that may allow them to exist in PAAL. Appendix A is a compilation of these species adapted from a number of park documents (Duran 2004; Hayes 2004; Lonard et al. 2004).

PHYSICAL RESOURCES

GEOLOGY

Geomorphology

Farmer (1992) described the LRGV, in which PAAL lies, as "a flat and relatively featureless plain." Thirty thousand years ago, the Rio Grande cut a broad deep valley through the area as sea levels dropped 450 feet. Deltaic and estuarine deposits were laid down starting about 18,000 years ago to form the current soils of PAAL. The current geology of the park is described as relict or a periodically active environment since hurricanes are the only force that brings new deposits to the site; its sediments are referred to as Holocene and Modern fluvial-deltaic. Mining and drilling for mineral and energy resources in the region have consisted of oil, gas, and caliche, but Farmer (1992) reported no nearby operations. Richard and Richardson (1993) placed PAAL in the Rio Grande delta plain. This delta is one of three large deltas resulting from deposits left by the melt waters of late Pleistocene glaciers. They characterized the resulting soils as clay or clay loams, saline, with generally poor drainage.

Soils

Seven soil types can be found in the Cameron County Soil Survey (Williams et al. 1977) and have been described on the site by Farmer (1992), Richard and Richardson (1993), and Lonard et al (2004). Farmer (1992) grouped these soils, as salt prairie (Lomalta Clay, Benito Clay, Latina Sandy Clay, Sejita Silty Clay Loam), levee (Laredo Silty Clay Loam), and transition soils (Chargo Silty Clay, Laredo Silty Clay Loam, Saline) that he based on salinity and drainage. Salt prairie soils are highly saline, have a generally flat or concave surface, retain water well, and are primarily found in the remnant meanders and the flood plains. Levee soils are found along the edges of the remnant meanders, are higher than the surrounding floodplains, have better drainage, and lower salinity levels. Vegetation grows well in these areas. Transition soils also exist next to remnant meanders but, as the name implies, the salinity levels, elevation, and water retention is somewhere between salt prairie soils and levee soils. Lomalta Clay is the predominant soil series in PAAL.

Soil samples were collected in limited areas of the park by a geomorphologist, Dave Diamond, during the mid-90's as a part of a study for the general management plan (D. Murphy, personal communication, 11 March 2004). No information is available on the results of this study.

Experts: Brown (Environmental Geologic Atlas of the Texas coastal zone), Williams (Soil survey of Cameron county) other possible sources: R. Nandigam or E. Heise (UT Brownsville)

HYDROLOGY

As of the 1998 General Management Plan there had been no hydrologic surveys conducted on the site (Palo Alto Battlefield National Historic Site 1998). During some recent resaca restoration projects, some preliminary hydrology monitoring was conducted (P. Pappas, personal communication, 11 March 2004). There is no information available on the results of this monitoring at this time.

Groundwater

In the 1992 natural resource survey, using data from the Texas Water Development Board (TWDB), Farmer (1992) described the groundwater of PAAL and the surrounding areas as poor quality and unproductive. Much of the groundwater in the area had high dissolved sodium, chloride, sulfate, boron, and nitrate and therefore was unsuitable for irrigation. Salinity levels under the battlefield were classified as moderately saline to very saline. Groundwater levels rose multiple feet since 1970 and were approximately 20 feet below the battlefield. A soil survey of Cameron County found the normal level for the water table ranges from 45 to 91 cm below the soil surface (Williams et al. 1977). Richards and Richardson noted the effect that the northern boundary canal has had on lowering the water content of surrounding soils, thereby altering the salinity levels of the soil and allowing woody vegetation to establish in areas that were historically cordgrass. This zone appears to be moving slowly to the south possibly due to the continued decrease of salinity. The Texas Water Development Board website has summaries and online databases of water levels and water quality as well summary reports for each of the counties in the state (Texas Water Quality Development Board 2004).

Experts: Texas Water Development Board

Surface water

General description

In their descriptions of PAAL, Farmer (1992) and Richard and Richardson (1993) described the existence of surface water in the park and surrounding areas. Natural wetlands occur in the area in old meanders or resacas of the Rio Grande although they vary in the persistence of water. Lacking streams, much of the surface water travels across PAAL in sheets (Palo Alto Battlefield National Historic Site 1997). To comply with Section 303(d) of the Clean Water Act, states are required to compile a list of impaired waters every two years. Because there are no waterways within the park, none of these listings are found in PAAL. Surface water in much of the LRGV is transported through man-made ditches such as the one that forms the northern boundary to the park. Because salt prairie habitat dominated the site and row crop agriculture was not successful, PAAL is generally free of scars caused by major drainage and irrigation ditches. However, PAAL was not without some modifications resulting from previous landuses. These changes have drastically altered the current surface water in PAAL. Richard and Richardson (1993)

noted four ponds and multiple old resaca beds at the park that vary in ability to retain water due in part to human influences such as installation of cattle tanks and drainage. The 1979 National Wetlands Inventory classified these depressions as temporary, seasonal, semipermenant, and saturated/semipermenant/seasonal (Cowardin et al. 1979). Cattle tanks also vary in ability to maintain a constant water supply, but Hayes (2004) described one cattle tank along the north portion of the park that is kept full by pumping water from a near by drainage ditch. When conducting surveys in 1992, Farmer (1992) found tanks in the southern portion of the park full, but some of the more northern tanks were empty. All areas within the park are above the tidal influence and are only occasionally flooded by saltwater during tropical storms or hurricanes. Flood maps from the Federal Emergency Management Agency show sixty percent of the park is in the 100-year floodplain (Palo Alto Battlefield National Historic Site 1997). According to Lonard et al. (2004), these periodic floods had been eliminated due to the dams and drainage projects in the area; where these depressions used to hold flood water from the river they now only retain water for short periods after heavy rains. Hayes (2004) found that many of the natural wetlands and much of the standing water had dried up in the park following three years of drought. Recent heavy rainfall has produced areas of standing water that were missing during the prolonged drought. Cultural studies are scheduled to be conducted to determine the extent of changes that have occurred on the landscape (P. Pappas, personal communication, May 2004).

*General water quality studie*s

A baseline inventory of water quality of PAAL, which examined data from Environmental Protection Agency's (EPA) databases, found 16 groups of parameters that exceeded water quality screening limits at least one time (between 1959 and 1997) in the study area (Horizon Systems Corp. 2002). None of the 21 monitoring stations located within the study area existed within the park boundaries. Ninety-nine percent of the water quality observations were taken downstream from PAAL in the Rio Grande and the Brownsville Ship Channel. Because no data were collected directly from surface water in PAAL, definitive statements on water quality were difficult to make. Based on the available data, the resulting summary report described waters that are likely impacted by anthropogenic activities such as development, stormwater runoff, agriculture, recreation, wastewater discharge, atmospheric deposition, and marine traffic.

Water quality data for surface water in the state, including the Brownsville area, has been monitored by the Texas Commission on Environmental Quality (TCEQ) since 2000. Data and summaries of the physical, chemical, and biological parameters of these waterbodies are listed on their website (TCEQ 2004b).

Wagner (1999a&b) sampled the salinity of pools of water remaining in resacas in mid-May in PAAL. He found extremely high salinity levels that were likely the cause of the lack of vegetation on these remaining pools. In a remediation of an arsenic-tainted cattle tank within the battlefield portion the park, water quality measurements were measured during March 2004 (D. Murphy, personal communication, 11 March 2004). There is no information available on the results of this monitoring at this time.

Experts: Farmer (Audubon), Richard (UT Brownsville; retired); I. Casares (TCEQ Water Section Manager Harlingen)

AIR QUALITY

As of 2003, there was no systematic collection of air quality data within the park and no plans to begin collection on site (P. Pappas, personal communication, 11 March 2004; Palo Alto Battlefield National Historic Site 1998). The 1997 Draft General Management Plan Environmental Assessment Plan listed PAAL's air quality designation under the Clean Air Act as a class II (Palo Alto Battlefield National Historic Site 1997). No large emission sources are located near the park and air quality is generally very good, although burning of nearby agricultural sites does occasionally cause high concentrations of particulate matter and smoke.

Although no data has been collected in the park, The Texas Natural Resource Conservation Commission (TNRCC) maintains a searchable database for historic and current air quality measurements (including 95 volatile organic compounds, such as benzene, toluene, ethylene, etc) for the state including one station in Brownsville (TCEQ 2004a). This site has been continuously monitoring air quality and meteorological parameters since 1998. Annual data summary reports are available from the state. Monitoring stations are operated by TCEQ, local government entities, or private monitoring networks. Data from these locations are contributing to a large study looking at the formation and transport of air pollutants along the gulf coast of Texas (T. Maniero, personal communication, May 2004; The University of Texas at Austin 2004).

The air quality of PAAL can be assessed from National Atmospheric Deposition Program/National Trends Network (NADP/NTN) data collected at the Beeville, Texas site (TX03, ~80 miles N of PAAL ~70 miles NW of PAAL) and the Corpus Christi, Texas site (#TX39, ~125 miles NW of PAAL) that began operations in January 2002. Trend data are not yet available for the latter site, but the Beeville site data show a slight decrease in wet sulfate and wet nitrate concentration, but no trend in wet ammonium concentration and deposition or in wet sulfate and wet nitrate deposition. The nearest NADP Mercury Deposition Network (MDN) sites are at Longview, Texas (#TX21), operational since November 1995 and at Fort Worth (#TX50), operational since August 2001, both ~475 miles N of PAAL. There are no MDN monitors in central or southeast Texas thus no meaningful mercury data exists (T. Maniero, personal communication, May 2004).

The nearest Clean Air Status and Trends Network (CASTNet) sites are at Big Bend NP, Texas (#BBE401 ~420 miles NW of PAAL) operational since 1995 and at Caddo Valley, Arkansas. (#CAD150, ~635 miles NE of PAAL), and the nearest Interagency Monitoring of Protected Visual Environments (IMPROVE) site is also at Big Bend NP, Texas (#BIBE) operational since 1988. These sites are all too distant to be meaningful for assessing acid deposition or visibility on PAIS. Installing an IMPROVE monitor at Padre Island NS would provide coverage for the Texas parks and is an option that should be considered (T. Maniero, personal communication, May 2004).

Experts: L. Gardner (TCEQ Waste/Air Section Manager Harlingen), Tonnie Maniero (NPS Air Quality specialist), Steve Spaw (TNRCC)

ECOSYSTEM STUDIES

Three general habitat types or zones are described in PAAL; Brushland, Salt Prairie, and Wetlands. Plant and animal associations have been created by Farmer (1992), Richard and Richardson (1993), Hayes (2004), and Lonard et al. (2004).

Experts: Richardson (UT Pan Am), Lonard (UT Pan Am; retired), Richard (UT Brownsville; retired), Hayes (Accipiter Biological Consultants)

BRUSHLAND

Brushland habitat covers about 23% of the area in PAAL (Farmer 1992; Haecker & Mauck 1997; Hayes 2004). The area adjacent to the meandering resacas is slightly higher in elevation, has better drainage, and allows soils to have a lower salinity than the neighboring salt prairie; therefore, it supports a different plant community. These areas exist for the most part from the southwest corner along the western side and curve along the northern boundary of the park. Smaller clumps of brushland also exist throughout the southern portion of the park on dunes or motitas, which lie next to former saline lakes, lagoons, or tidal flats (Haecker & Mauck 1997). These elevated areas are dominated by honey mesquite (*Prosopis glandulosa*), spiny hackberry (*Celtis pallida*), Texas ebony (*Pithecellobium flexicaule*), and common anaqua in the overstory, and jujube or lotebush (*Zizyphus obtusifolia*), colima lime pricklyash (*Zanthoxylum fagara*), and Lindheirmer's prickly pear (*Opuntia lindheirmeri*) as the understory. Farmer (1992) also described transitional soils in the northern portion of the park that support mesquite grassland. This transitional vegetation zone varies from dense brush to sparse mesquite over *S. spartinae* grassland. Farmer (1992) noted approximately 38 brush species, most of which were semi-deciduous. Hayes (2004) found that this increased species diversity is important for the fauna community as it provides a greater resource for the community than the other habitats within the park. Richard and Richardson (1993) documented a variety of animal species that rely on this habitat and are part of this ecosystem, and Farmer (1992) noted various avian species roosting, nesting, or generally using this habitat. This habitat is also of particular interest for two endangered cats, the ocelot and jaguarundi.

About 95% of the native brushland in the LRGV has been converted to agriculture. Agricultural activities destroyed large tracts of the brushland in PAAL during the middle of the last century. This area has not reverted back to its natural state through succession and is currently dominated by non-native species. In their management recommendations, both Hayes (2004) and Farmer (1992) suggested reverting these altered areas back to brushlands, because it would restore the historical landscape as well as provide habitat for the highest variety and abundance of animal species. Due to its importance to many species and the extreme loss of this habitat to agriculture

and urban uses, it is one of the top priorities for acquisition by the U.S. Fish and Wildlife Service (Farmer 1992). Although cattle grazing has created some disturbed areas and some of the habitat has been cleared for agriculture, Richard and Richardson (1993) feel the remaining habitat has changed very little since 1846.

SALT PRAIRIE

Salt prairie habitat is the largest system on the PAAL covering 75% of the land area. This vegetation type exists in areas of low elevation where there is increased salt build-up due to poor drainage, and includes the Coastal Prairie, Sacatal, and Borrichia prairie vegetation types described in Richard and Richardson (Farmer 1992; Haecker & Mauck 1997; Hayes 2004; Richard & Richardson 1993). Within the salt prairies, natural depressions, which once were frequently flooded, may now be dry most of the year due to excavation of cattle tanks and disruption of the resacas. It is likely that this vegetation type has increased over the years due to the erosion and infill of resacas. Within the *S. spartinae*-dominated salt prairie are patches slightly lower in elevation in which concentrated salt levels create what is known as Borrichia or salt flats, which support primarily *B. frutescens* and succulents among the bare patches of soil. Mesquites and yuccas are scattered and locally common in places. Most of the habitat has not been disrupted by agricultural activities due to its high salinity, although one section in the center of the park still shows scars of past plow lines. Both Farmer (1992) and Richard and Richardson (1993) found portions of the land were burned to promote new green growth for cattle grazing. In their description of species associated with this habitat, Richard and Richardson (1993) described the association between the abundant snails and fiddler crabs, and their primary consumers. A list of insectivores primarily found in salt prairies as well as those that may also be found in brushland are mentioned. They also identify the importance of this habitat to the endangered or state listed Texas Botteri's Sparrow. Both Farmer (1992) and Hayes (2004) noted the high use of salt prairies in the park by the Texas Botteri's Sparrow during the breeding season, and by foraging raptor species year-round. Additionally, the endangered jaguarundi is thought to make greater use of salt prairies than the ocelot.

WETLANDS

Wetlands consist of about two percent of the total area in the park, and are made up primarily of abandoned channels and tributaries of the Rio Grande as well as man-made cattle tanks (Hayes 2004). The former channels of the Rio Grande were naturally cut off from the river as it shifted over time, creating oxbow lakes (i.e., resacas). Many resacas filled with sediment overtime from erosion and now support wetland species. The wetlands on the site vary according to the persistence of water, but one in the north central portion of the park appears to be the only one with permanent water due to pumping from a nearby drainage ditch. The National Audubon Society has observed large numbers of wading birds using these habitats within the park (Farmer 1992). The seasonal nature of some of the wetlands led Farmer (1992) to hypothesize that some amphibians unique to the LRGV could benefit as larger predatory fishes cannot survive in these conditions. Four of the six frogs detected by Richard and Richardson (1993) were found in tanks and resacas and 10 fish species were identified (9 euryhaline and 1 freshwater) in the tank north

of Arista's Hill. Farmer (1992) and Hayes (2004) recommended excavating some of the wetlands, which filled in prematurely due to agricultural activities during the middle of the last century, to restore valuable wetland habitat for many wading birds.

The alterations in hydrology and the recent drought have greatly affected the composition and densities of the wetland community. Sanches pond and a shallow resaca in the park were seined during a one-day effort in 1999 to examine the existing fish community. No fish were detected in the resaca likely due to the lack of inflow from adjacent waterways and the total dependence on rainfall and drainage for its water source (McNeely 1999). When Hayes (2004) attempted to quantify species richness and abundance of fish in PAAL, only one area on the site had water and this area had receded beyond capacity for fish. In a herpetological study, Duran (2004) found a number of species that exist within the county were not located in the park, likely due to the lack of available fresh water. He hypothesized that additional species may be detected in future studies if surveys can be conducted during periods of increased rainfall. Two Texas state endangered species, the black spotted newt and the Rio Grande siren, could possibly exist within the park if rainfall levels increased and created standing water in the park for more than a day or two. The reduction in open water also has possibly affected the density and species richness of bat species detected in the park (Hayes 2004). During surveys only one species was detected, although an additional nine species could occupy the park based on distribution maps.

MANAGEMENT ISSUES

Because of the park's proximity to Brownsville and the rapid growth of the city, it is subject to many environmental problems, including disturbed lands, disruption of waterflow, disruption of natural plant communities, and the introduction of exotic and pest species. A detailed list of management issues and concerns that face PAAL and how these issues may affect the park's resources can be found in Appendix B. Two of these major issues are discussed below.

EXOTIC SPECIES

Plants

Lonard (2004) documented 20 exotic plant species in PAAL, a number of which are possibly invasive, including Kleberg's Bluestem (*Dichanthium annulatu*), angleton bluestem (*D. aristatum*), chandelier plant (*Kalanchoe delagoensis*), buffelgrass (*Pennisetum ciliare*), guineagrass (*Urochloa maximum*), and liverseed grass (*U. panicoides*). Many of these exist in the core battlefield site and along roadways. There are no current plans to eradicate these species.

Animal

The review and survey conducted by Hayes (2004) documented five non-native vertebrate species, feral pig, nilgai, Norway rat, black rat and European house sparrow, on the site. All

species are thought to have a detrimental effect on native populations either through direct competition for resources (e.g., food, water, and habitat) or indirectly through the destruction of native vegetation and transmittal of disease. The current recommendation is the eradication of these species from the park although presently there is no such plan to do so.

ADJACENT AND PREVIOUS ON-SITE LANDUSE IMPACTS

Previous Landuses

Although PAAL has largely escaped the dramatic alterations seen in much of the LRGV due to its high salinity soils, the area does show effects from previous landuses including grazing and farming, excavating and blocking of canals, creation of tanks in marshes, and road building, which has altered the vegetation communities and hydrology of the area (Farmer 1992; Haecker & Mauck 1997; Lonard et al. 2004; Richard & Richardson 1993). Large areas of brushland habitat were cleared in PAAL for farming operations and have not reverted back to their natural state through succession (Farmer 1992; Richard & Richardson 1993). Central areas in the battlefield still have not recovered from attempts in the 1960's to introduce non-native vegetation for cattle grazing. Richard and Richardson (1993) found that the destruction of brushland habitat for cattle grazing has lead to an increase in herbaceous herbs. Lonard et al. (2004) documented the highest number of species in areas disturbed by farming, grazing, or road building including 20 introduced species. Erosion resulting from the agricultural activities within the park has dramatically increased the speed by which the resacas filled with sediment, which resulted in a change in vegetation (Farmer 1992; Richard & Richardson 1993). Additionally, Richard and Richardson (1993) proposed that the Huisachal habitat lining the canal that marks the northern boundary is spreading southward due to the reduction in salinity of the surrounding soil due to drainage into the canal. A change in Salt Prairies to Brushland has also been noted, possibly due to past grazing, drying of the soil, or lack of burning. Due to the cultural importance of some of these areas, the park will need to focus on the preservation of the prairie in such areas (P. Pappas, personal communication, May 2004).

Restoration

The NPS has proposed to restore this land to the historic landscape of the first battle of the Mexican-American War (1846-1848). Accounts of historical vegetation recorded in U.S. Grant's war diary noted the gulf cordgrass covering the core battlefield. However, this community requires saline, hydric soils with periodic flooding of the river (Sanchez 1985 *in* Lonard et al. 2004). Current modifications to the landscape have reduced flooding to an infrequent occurrence limited to rainwater. Therefore, in order to restore this area to a *S. spartinae* marsh, the surrounding resacas would have to be excavated and cyclic flooding returned to recreate the natural water flow. Due to these extreme restoration requirements, it is unlikely that the core battlefield can be restored to its historic vegetation (Lonard et al. 2004). Recent heavy rainfall has produced areas of standing water that were missing during the prolonged drought. Cultural studies are scheduled to be conducted to determine the extent of changes that have occurred on the landscape (P. Pappas, personal communication, May 2004).

Adjacent landuses

The 1994 Land Protection Plan listed a number of potential problems arising from activities outside of the park (Palo Alto Battlefield National Historic Site 1994a). Road improvements are scheduled along the western and southwestern edges of the park on FM 511 (four lanes to six lanes) and FM 1847 and will likely increase traffic along that route and stimulate commercial and industrial development around PAAL. Additionally, land just west of FM 1847 contains important wildlife habitat as well as cultural resources and could be impacted by road improvements or increased development. Possible expansion of the industrial complex (including chemical and petroleum refineries) associated with the Brownsville ship channel constitute visual and air quality threats to the park. A number of proposals by the city of Brownsville may also affect the park including alterations to current zoning and the installation of an oil pipeline in the vicinity of the park. Desalinization of ground water by a nearby company could cause problems for the park as it draws water from the same ground water source. Additionally there are concerns about the disposal of the extracted salt (D. Murphy, personal communication, 11 March 2004).

Urban sprawl has occurred very rapidly in the past 10 years. If this rapid growth rate continues PAAL will become an urban park in the future, with increasing management problems due to human-wildlife interaction and landuse issues from outside the park.

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Appendix A. Federal and State Listed Species that have been documented in or are possible inhabitants of PAAL.

Species	Scientific name	Status
Plants		
No documented or suspected species		
Mammals		
Ocelot	*Felis pardalis*	Federally Endangered; Texas State Endangered
Reptiles		
Texas tortoise	*Gopherus berlandieri*	Texas State Threatened
Texas horned lizard	*Phrynosoma cornutum*	Texas State Endangered
Texas indigo snake	*Drymarchon corais erebennus*	Texas State Endangered
Amphibians		
Mexican tree frog	*Smilisca baudinii*	Texas State Endangered
Birds		
Aplomodo Falcon	*Falcon femoralis*	Federally Endangered; Texas State Endangered
Brownsville Common Yellowthroat	*Geothlypis trichas insperata*	Federal Species of Concern
Ferruginous Hawk	*Buteo regalis*	Federal Species of Concern
Loggerhead Shrike	*Lanius ludovicianus*	Federal Species of Concern
Reddish Egret	*Egretta rufescens*	Federal Species of Concern; Texas State Threatened
Texas Botteri's Sparrow	*Aimophila botterii texana*	Federal Species of Concern
Texas Olive Sparrow	*Arremonops rufivirgatus rufivirgatus*	Federal Species of Concern; Texas State Threatened
White-faced Ibis	*Plegadis chihi*	Federal Species of Concern; Texas State Threatened
White-tailed Hawk	*Buteo albicaudatus*	Texas State Threatened
Wood Stork	*Mycteria americana*	Texas State Threatened
Fish		
No documented or suspected species		
Invertebrates		
No documented or suspected species		

Appendix B. Management issues and concerns that face PAAL and how these issues may affect the park's resources

Management Issues	Priority	Significant Natural Resources Impacted	Monitoring Questions
Air Quality (Compliance with Clean Air Act)	HIGH	Natural resources of cultural landscape	Effects of nearby highways, and factories on natural resources
Climate Change	HIGH	Cultural natural landscape especially in relation to hydrology	Effects of drought, heat on vegetation change
Data Gaps	HIGH	All natural resource	What species in park
Exotics (Animals)	HIGH	Should/How can Nilgai and feral hogs be controlled	Affects on plant live from foraging, rooting
Floodplain protection	HIGH	Viewshed, cultural landscape. Primary involves non NPS owned lands in boundary	Impacts of activity on floodplain compromised?
Native Pests	HIGH	Plant composition	At PAAL vegetation is the pest how do we control spread of mesquite into prairie areas
Non-NPS/ Inholding Issues	HIGH	Viewshed, cultural landscape. Non NPS properties w/in park boundary	Will inability to purchase lands w/in boundary affect park, how do ranching activities affect park resources
Outside Development	HIGH	Viewshed, cultural/natural landscape	Effects as development increases on park boundary
Viewscape	HIGH	Natural and Cultural landscape	What are effects on development on park borders
Genetic Contamination	MED	Natural landscape	Affect of non-native grasses and decorative plants on environment
Migratory Birds	MED	Wetlands, habitat areas	What migratory birds come to park, in what numbers,
Native Vegetation Restoration	MED	Native grasslands	How best to reintroduce native grassland areas (no completely wiped out but constricted
Soundscape	MED	Cultural/natural landscape	What is effect of traffic noise from new interstate on wildlife
T&E Species	MED	Critical habitat	Is park development affecting endangered species
Water Quality (Ground)	MED	Soil, water, wildlife in vicinity of dipping tasks	Is ground water contaminated
Water Quantity (Ground Water)	MED	Resaca system	Will reconstruction of resacas affect water table
Water Quantity (Surface Water)	MED	Resaca system	Will reconstruction of resacas produce wetlands
Wetlands	MED	Aquatic vegetation, amphibians, fish. Wetlands as part of surface water issue	Can resaca restoration reestablish wetland areas effect on cultural landscape
Adjacent Landuse	LOW	NA	NA
Adjacent Landuse	LOW	NA	NA
Erosion	LOW	Natural landscapes	Are exotic species, period inundation causing erosion

Appendix B. Continued.

Management Issues	Priority	Significant Natural Resources Impacted	Monitoring Questions
Exotics (Plants)	LOW	NA	NA
Fire Management	LOW	Entire cultural and natural landscape	How should fire be managed
Fishing (Rec & Comm)	LOW	NA	NA
Forest pests/Diseases	LOW	Are there pests/diseases? No know pests, limited forest areas.	Are park woodlands in good health? Are forest pest populations within acceptable limits?
Hunting & Trapping	LOW	No hunting	Would hunting help control/eliminate exotics
Mining	LOW	NA	NA
Native Species Overpopulation	LOW	Cultural landscape	Does outside development lead to migration into park
Native Wildlife Reintroductions	LOW	NA	NA
Night Sky	LOW	NA	NA
Oil/Gas	LOW	Prairie landscape near planned pipeline	Impact of pipeline
Poaching	LOW	Exotics and invasives	IS poaching occurring
Right-of-ways/Easements	LOW	Viewshed	Impact of activity and development in right-of-ways
Slope Failure	LOW	NA	NA
Subsidence	LOW	NA	NA
Visitor Overuse	LOW	N/A	How will opening site to visitors affect the site(
Water Quality (Surface) (Compliance with Clean Water Act)	LOW	NA	NA
With/In Park Development	LOW	NA	NA

GIS DATA, DATA SETS

A list of available spatial and non-spatial data is provided for the park. Data have been organized into the following groups: GIS data, non-GIS digital maps, hardcopy maps, digital databases, digital publications, NatureBib maps and abbreviations. GIS data have been further separated into three categories: park specific or local, statewide, and nationwide. A unique identifier has been given to each line of data as follows: "X_#", where "X" is a letter describing the data type (L=local GIS, S=Statewide GIS, N=Nationwide GIS, M=digital map, I=interactive map, D=database, and P=publication) and "#" is a unique number. Basic information is provided to allow quick review of the publicly available data, including the title of the data and the organization from which the data are available. To view more extensive details about the data, an EXCEL workbook has been provided. The EXCEL workbook includes several datasheets for each of the aforementioned data categories. Among some of the additional details provided in the EXCEL workbook are partial metadata, web addresses, and descriptions of the data. Blank fields within the EXCEL workbook represent information that were not readily available, but can be gathered at a later date with a more in-depth search of the available metadata.

General Park Information

County	Cameron
Zip Code	78520
Spatial Extent	26.04N 26.00S -97.44E -97.44W
Quadrangles	Los Fresnos
River Basin	Rio Grande
Watershed	South Laguna Madre
HUC	12110208

Local: by Quarter-Quad, Quad, County or Watershed

ID	Available From	Originator/ Publisher	Location	Data	Scale	Structure	Resolution
L_1	TNRIS	USGS	Los Fresnos	DRG	1:24,000	Vector	
L_2	TNRIS	USGS	Los Fresnos	DRG	1:100,000	Vector	
L_3	TNRIS	USGS	Los Fresnos	DRG	1:250,000	Vector	
L_4	TNRIS	USGS	Los Fresnos_NW	DOQQ	1:12,000	Raster	1 m
L_5	TNRIS	USGS	Los Fresnos_NE	DOQQ	1:12,000	Raster	1 m
L_6	TNRIS	USGS	Los Fresnos_SW	DOQQ	1:12,000	Raster	1 m
L_7	TNRIS	USGS	Los Fresnos_SE	DOQQ	1:12,000	Raster	1 m
L_8	TNRIS	USGS	Los Fresnos_NW	DOQQ	1:12,000	Raster	10 m
L_9	TNRIS	USGS	Los Fresnos_NE	DOQQ	1:12,000	Raster	10 m
L_10	TNRIS	USGS	Los Fresnos_SW	DOQQ	1:12,000	Raster	10 m
L_11	TNRIS	USGS	Los Fresnos_SE	DOQQ	1:12,000	Raster	10 m
L_12	TNRIS	USGS	Los Fresnos_NW	DOQQ	1:12,000	Raster	30 m
L_13	TNRIS	USGS	Los Fresnos_NE	DOQQ	1:12,000	Raster	30 m
L_14	TNRIS	USGS	Los Fresnos_SW	DOQQ	1:12,000	Raster	30 m
L_15	TNRIS	USGS	Los Fresnos_SE	DOQQ	1:12,000	Raster	30 m
L_16	TNRIS		Cameron County	DOQ Mosaic	1:12,000	Raster	1 m
L_17	TNRIS	USGS	Los Fresnos	DEM	1:24,000	Raster	30 m
L_18	TNRIS	USGS	Los Fresnos	Hypsography (DLG)	1:24,000	Vector	
L_19	TNRIS	USGS	Los Fresnos	Hydrography (DLG)	1:24,000	Vector	
L_20	USGS	USGS	South Laguna Madre Watershed	NHD	1:100,000	Vector	
L_21	TNRIS	NRCS	Cameron County	Soil	1:24,000	Vector	1 m
L_22	TNRIS	TxDOT	Cameron County	Transportation (Urban)		Vector	
L_23	TNRIS	TWDB	Harlingen Degree (26S 27N 97E 98W)	Hillshade		Vector	
L_24	TNRIS		Harlingen Degree (26S 27N 97E 98W)	NED		Raster	
L_25	RRC	RRC	Cameron County	Pipeline and Well		Vector	

Texas State-Wide

ID	Available From	Originator/Publisher	Location	Data	Scale	Structure	Resolution
S_1	BEG	BEG	State	Oil and Gas Reservoirs		Vector	
S_2	FEMA	FEMA	State	Q3 Flood Data			
S_3	NRCS		State	Precipitation			
S_4	TCEQ		State	Designated Stream Segments		Vector	
S_5	TCEQ		State	Stream Segment Boundaries		Vector	
S_6	TGLO	USACE/TGLO	State	Anchorage Areas		Vector	
S_7	TGLO	TGLO	State	Aquaculture Facilities	1:24,000	Vector	
S_8	TGLO	TGLO	State	Audubon Sanctuaries		Vector	
S_9	TGLO	NOAA/TGLA	State	Bathymetry		Vector	
S_10	TGLO	NOAA/TGLA	State	Bathymetry (6-food depth)		Vector	
S_11	TGLO	TGLO	State	Beach Access	1:24,0000	Vector	
S_12	TGLO	TPWD	State	Boat Ramps	1:24,0000	Vector	
S_13	TGLO	TGLO	State	Cabins	1:24,000	Vector	
S_14	TGLO	TxDOT	State	City and County Parks	1:24,000	Vector	
S_15	TGLO	TxDOT	State	City Limits		Vector	
S_16	TGLO	TGLO	State	Coastal Leases	1:24,000	Vector	
S_17	TGLO	TGLO/TPWD	State	Colonial Waterbird Rookery Areas	1:24,000	Vector	
S_18	TGLO	TNRCC	State	County Boundaries	1:24,000	Vector	
S_19	TGLO		State	Dispersant Use Pre-Approval Zone		Vector	
S_20	TGLO	USGS, TGLO	State	Elevation	1:250,000	Vector	
S_21	TGLO	TGLO/BEG	State	Environmental Sensitivity Index Shoreline		Vector	
S_22	TGLO	USACE/TGLO	State	Gulf Intracoastal Waterway/Ship Channels	1:24,000	Vector	
S_23	TGLO	TxDOT/TGLO	State	Heliports	1:24,000	Vector	
S_24	TGLO		State	Hydrography (coastal)	1:24,000	Vector	
S_25	TGLO	TxDOT/TGLO	State	Hydrography (detailed)	1:24,000	Vector	
S_26	TGLO	USGS	State	Hydrography (general)	1:2,000,000	Vector	
S_27	TGLO	TxDOT	State	Hydrography (general)	1:24,000	Vector	
S_28	TGLO	TGLO	State	National Wildlife Refuges	1:24,000	Vector	
S_29	TGLO	TPWD	State	Natural Regions (major)		Vector	
S_30	TGLO	TPWD	State	Natural Regions (sub)		Vector	
S_31	TGLO		State	Oil and Gas Pipelines		Vector	
S_32	TGLO	USGS/TGLO	State	Place Names	1:24,000	Vector	
S_33	TGLO	TGLO	State	Place Names	1:750,000	Vector	

Texas State-Wide

ID	Available From	Originator/Publisher	Location	Data	Scale	Structure	Resolution
S_34	TGLO	TGLO	State	Place Names (populated)		Vector	
S_35	TGLO	TxDOT	State	Railroads	1:24,000	Vector	
S_36	TGLO	TWDB	State	Rainfall			
S_37	TGLO	USDOT	State	Roads/Highways	1:24,000	Vector	
S_38	TGLO	NOAA/NOS/NGS	State	Shoreline	variable (source scale is listed in attribute table of features)	Vector	
S_39	TGLO	TPWD	State	State Parks/Wildlife Management Areas	1:24;000	Vector	
S_40	TGLO	TGLO	State	Submerged Lands		Vector	
S_41	TGLO	USGS/TGLO	State	Topography	1:250,000	Raster	5000 ft
S_42	TGLO	TGLO	State	Urban Areas	1:24,000	Vector	
S_43	TGLO	TPWD	State	Vegetation Areas		Vector	
S_44	TGLO (NRI)	TNRCC	State	Air Monitoring Stations	1:24,000/1:100,000	Vector	
S_45	TGLO (NRI)	RRC	State	Tidal Disposal Facilities		Vector	
S_46	TGLO (NRI)	TNRCC	State estuaries and tidal tributaries	Water and Sediment Quality Sample Locations		Vector	
S_47	TNRCC	TCEQ	State	Surface Water Rights Diversion Points		Vector	
S_48	TNRIS	USGS	State	Active Mines and Mineral Plants			
S_49	TNRIS	TCEQ	State	Air Monitoring Sites		Vector	
S_50	TNRIS	TCEQ	State	Air Quality Nonattainment and Near Nonattainment Areas		Vector	
S_51	TNRIS		State	Airports		Vector	
S_52	TNRIS		State	Cities			
S_53	TNRIS		State	County Boundaries	1:250,000		
S_54	TNRIS		State	County Boundaries (with 15 League Limit)			
S_55	TNRIS		State	County Boundaries (with coastline)	1:24,000		
S_56	TNRIS		State	County Boundaries (with generalized coastline)	1:24,000		
S_57	TNRIS		State	Highways		Vector	
S_58	TNRIS	TCEQ	State	Industrial and Hazardous Waste Sites		Vector	
S_59	TNRIS		State	Land Use/Land Cover		Vector	
S_60	TNRIS	TCEQ	State	Landfills		Vector	
S_61	TNRIS	USGS	State	Mineral Availability System			

Texas State-Wide

ID	Available From	Originator/Publisher	Location	Data	Scale	Structure	Resolution
S_62	TNRIS	USGS	State	Mineral Resource Data			
S_63	TNRIS		State	National Parks			
S_64	TNRIS	TPWD	State	Natural Regions (major)		Vector	
S_65	TNRIS	TPWD	State	Natural Regions (sub)		Vector	
S_66	TNRIS		State	Precipitation			
S_67	TNRIS	TCEQ	State	Public Water Supply Sources		Vector	
S_68	TNRIS		State	Quads (1 degree blocks)		Vector	
S_69	TNRIS		State	Quads (1:100,000)		Vector	
S_70	TNRIS		State	Quads (1:12,000; 3.75 minute)		Vector	
S_71	TNRIS		State	Quads (1:24,000; 7.5 minute)		Vector	
S_72	TNRIS	TCEQ	State	Radioactive Waste Sites		Vector	
S_73	TNRIS		State	Railroads		Vector	
S_74	TNRIS		State	Reservoirs		Vector	
S_75	TNRIS	TLC	State	School District Boundaries			
S_76	TNRIS		State	State Parks			
S_77	TNRIS		State	STATSGO (soils)			
S_78	TNRIS		State	Streams		Vector	
S_79	TNRIS	TCEQ	State	Superfund Sites		Vector	
S_80	TNRIS	TCEQ	State	TCEQ Regions			
S_81	TNRIS	TLC	State	Texas House Districts			
S_82	TNRIS		State	Urban Areas			
S_83	TNRIS	TPWD	State	Vegetation Types		Vector	
S_84	TNRIS		State	zip codes			
S_85	TWDB		State	Basins		Raster	
S_86	TWDB		State	Economically Distressed Areas			
S_87	TWDB	TWDB	State	Existing Conveyances		Vector	
S_88	TWDB	BEG	State	Existing Reservoirs		Vector	
S_89	TWDB	not available	State	Groundwater Conservation Districts		Vector	
S_90	TWDB	not available	State	Groundwater Management Areas		Vector	
S_91	TWDB	TWDB	State	Hillshade		Raster	
S_92	TWDB	USGS	State	Hydraulic Unit Code (HUC)	1:500,000	Vector	
S_93	TWDB	TWDB	State	Major Aquifers	1:250,000	Vector	
S_94	TWDB	USGS	State	Major Rivers	1:2,000,000	Vector	

Texas State-Wide

ID	Available From	Originator/Publisher	Location	Data	Scale	Structure	Resolution
S_95	TWDB	TWDB	State	Minor Aquifers	1:250,000	Vector	
S_96	TWDB	not available	State	OPFCA Regions and Field Office		Vector	
S_97	TWDB	TWDB	State	Priority Groundwater Management Areas		Vector	
S_98	TWDB	TWDB	State	Proposed Conveyances		Vector	
S_99	TWDB	BEG	State	Recommended Reservoirs		Vector	
S_100	TWDB	TWDB	State	Regional Water Planning Areas		Vector	
S_101	TWDB	not available	State	River Authorities and Special Law Districts	1:100,000 (rivers), 1:500,000 (basins)	Vector	
S_102	TWDB	USGS	State	River Basins	1:500,000	Vector	
S_103	TWDB	not available	State	StratMap County Boundaries with Coastline	1:24,000	Vector	
S_104	TWDB	not available	State	StratMap County Boundaries without Coastline	1:24,000	Vector	
S_105	TWDB	not available	State	StratMap Municipality Boundaries	1:24,000	Vector	
S_106	TWDB	not available	State	StratMap Texas State Boundary with Coastline	1:24,000	Vector	
S_107	TWDB	not available	State	StratMap Texas State Boundary without Coastline	1:24,000	Vector	
S_108	TWDB	TWDB	State	Submitted Drillers Report Database		Vector	
S_109	TWDB	TWDB	State	Terrain		Raster	
S_110	TWDB	Texas Legislative Council	State	Texas House Districts (2002)		Vector	
S_111	TWDB	Chris Daly (Oregon State University) and George Taylor (Oregon Climate Service at Oregon State University)	State	Texas Precipitation		Vector	
S_112	TWDB	Texas Legislative Council	State	Texas Senate Districts (2002)		Vector	
S_113	TWDB	TWDB	State	TWDB Groundwater Database Welldata		Vector	
S_114	TWDB	TWDB	State	Well Location Grid			
S_115	USEPA	USGS	State-Southeast	Multi-Resolution Land Characteristics Consortium (National Land Cover Data)		Raster	30 m
S_116	USFS	USFS	State-Southeast	LAA - Forest Area Connectivity		Raster	30 m
S_117	USFS	USFS	State-Southeast	LAA - Forest Area Density		Raster	30 m
S_118	USFS	USFS	State-Southeast	LAA - Forest Fragmentation Index		Raster	30 m
S_119	USFS	USFS	State-Southeast	LAA - Human Use Index		Raster	30 m
S_120	USFS	USFS	State-Southeast	LAA - Land Cover Contagion		Raster	30 m
S_121	USFS	USFS	State-Southeast	LAA - Land Cover Diversity		Raster	30 m
S_122	USFS	USFS	State-Southeast	LAA - Landscape Pattern Type Index A		Raster	30 m

Texas State-Wide

ID	Available From	Originator/Publisher	Location	Data	Scale	Structure	Resolution
S_123	USGS	USGS	State	GAP Analysis Project			

Nationwide

ID	Available From	Originator/ Publisher	Location	Data	Scale	Structure	Resolution
	http://mrdata.usgs.gov/sddpftp.html						
N_1	USGS	USGS	Nationwide	Igneous rocks PLUTO		Vector	
N_2	USGS	USGS	Nationwide	NURE Sediment Chemistry		Raster	
N_3	USGS	USGS	Nationwide	Soil Chemistry		Vector	
N_4	USGS	USGS	Nationwide	Soils PLUTO		Vector	
N_5	USGS	USGS	Nationwide	Soils RASS		Vector	
N_6	USGS	USGS	Nationwide	Unconsolidated Sediments PLUTO		Vector	
N_7	USGS	USGS	Nationwide	Unconsolidated Sediments RASS		Vector	
N_8	USGS	USGS	Nationwide	US Geology	1:2,500,000	Raster	1000 m
N_9	USGS	USGS	Nationwide	US Geology [Geologic Faults]	1:2,500,000	Raster	1000 m
N_10	USGS	USGS	Nationwide	US Aeromagnetics		Raster	1000 m
N_11	USGS	USGS	Nationwide	US Bouguer Gravity Field		Raster	4 km
N_12	USGS	USGS	Nationwide	US Isostatic Gravity Field		Raster	4 km
N_13	USGS	USGS	Nationwide	US Magnetics NW Illumination		Raster	2 km
N_14	USGS	USGS	Nationwide	Active Mines and Mineral Plants		Vector	
N_15	USGS	USGS	Nationwide	Mineral Availability System		Vector	
N_16	USGS	USGS	Nationwide	Mineral Resource Data		Vector	
N_17	TNRIS		Nationwide	USA Boundary			
N_18	TGLO	NPS, WRD	Nationwide	National Parks	1:24,000	Vector	
N_19	USGS	USGS	Nationwide	Cities	1:2,000,000	Vector	
N_20	USGS	USGS	Nationwide	Counties		Vector	
N_21	USGS	USGS	Nationwide	Elevated Shaded Relief		Raster	2km
N_22	USGS	USGS	Nationwide	Federal Lands	1:2,000,000	Vector	
N_23	USGS	USGS	Nationwide	Hydrologic Units	1:250,000 and 1:100,000	Vector	
N_24	USGS	USGS	Nationwide	Hydrology	1:2,000,000	Vector	
N_25	USGS	USGS	Nationwide	Land Cover		Raster	1000 m
N_26	USGS	USGS	Nationwide	Railroads	1:100,000	Vector	
N_27	USGS	USGS	Nationwide	Roads	1:3,000,000	Vector	
N_28	USGS	USGS	Nationwide	Urban Areas		Vector	
N_29	USGS	USGS	Nationwide	USA	1:25,000,000	Vector	
N_30	USGS	USGS	Nationwide	24000 Quadrangle Boundaries		Vector	
N_31	USGS	USGS	Nationwide	250000 Quadrangle LU/LC	1:250,000	Vector	

Nationwide

ID	Available From	Originator/ Publisher	Location	Data	Scale	Structure	Resolution
	www.epa.gov/mrlc/data.html (links to spatial and non-spatial data, nationwide)						
N_32	USFS	USFS	13 state region (including TX, LA, MS)	LAA - Assessment Projects by watershed		Vector	
N_33	USFS	USFS	13 state region (including TX, LA, MS)	LAA - Assessment Projects by county		Vector	
N_34	USFS	USFS	13 state region (including TX, LA, MS)	LAA - Assessment Projects by ecoregion		Vector	
N_35	USGS	USGS	Nationwide	Geology of the US			
N_36	NRCS/USDA	NRCS/USDA	Nationwide	Tiger 2002 Road			
N_37	NRCS/USDA	NRCS/USDA	Nationwide	Tiger 2002 Railroad			
N_38	NRCS/USDA	NRCS/USDA	Nationwide	Tiger 2002 hydrography			
N_39	NRCS/USDA	NRCS/USDA	Nationwide	Tiger 2000 water			
N_40	NRCS/USDA	NRCS/USDA	Nationwide	FEMAQ3 Flood Data	1:24,000		
N_41	NRCS/USDA	NRCS/USDA	Nationwide	8-digit hydrologic units	1:250,000		
N_42	NRCS/USDA	NRCS/USDA	Nationwide	DRG County Mosaic			
N_43	NRCS/USDA	NRCS/USDA	Nationwide	DRG	1:24,000		
N_44	NRCS/USDA	NRCS/USDA	Nationwide	DRG	1:100,000		
N_45	NRCS/USDA	NRCS/USDA	Nationwide	DRG	1:250,000		
N_46	NRCS/USDA	NRCS/USDA	Nationwide	Quad 1:24,000 map index			
N_47	NRCS/USDA	NRCS/USDA	Nationwide	Quad 1:100,000 map index			
N_48	NRCS/USDA	NRCS/USDA	Nationwide	Quad 1:250,000 map index			
N_49	NRCS/USDA	NRCS/USDA	Nationwide	Quad 1 degree by state map index			
N_50	NRCS/USDA	NRCS/USDA	Nationwide	National Elevation Dataset			
N_51	NRCS/USDA	NRCS/USDA	Nationwide	DEM			
N_52	NRCS/USDA	NRCS/USDA	Nationwide	DOQ County Mosaic by APFO			
N_53	NRCS/USDA	NRCS/USDA	Nationwide	ErMapper Ortho Mosaic by NRCS			
N_54	NRCS/USDA	NRCS/USDA	Nationwide	National Land Cover Dataset by State			
N_55	NRCS/USDA	NRCS/USDA	Nationwide	Soil Survey Geographic (SSURGO) data base			
N_56	NRCS/USDA	NRCS/USDA	Nationwide	Annual Average Precipitation by state			
N_57	NRCS/USDA	NRCS/USDA	Nationwide	Monthly Average Precipitation by state			
	http://nationalatlas.gov/atlasftp.html						
N_58	NationalAtlas	USDA/NRCS	Nationwide	Average Annual Precipitation	1:2,000,000	Vector	

Nationwide

ID	Available From	Originator/ Publisher	Location	Data	Scale	Structure	Resolution
N_59	NationalAtlas	USGS	Nationwide	Breeding Bird Survey Routes	1:2,000,000	Vector	
N_60	NationalAtlas	USGS	Nationwide	County Boundaries	1:2,000,000	Vector	
N_61	NationalAtlas	USACE	Nationwide	Dams	1:2,000,000	Vector	
N_62	NationalAtlas	USFS	Nationwide	Ecoregions	1:2,000,000	Vector	
N_63	NationalAtlas	USFS/USGS	Nationwide	Forest Cover Types	1:2,000,000	Raster	
N_64	NationalAtlas	USGS	Nationwide	Forest Fragmentation Classification	1:2,000,000	Raster	
N_65	NationalAtlas	USEPA/USGS	Nationwide	Forest Fragmentation Causes	1:2,000,000	Raster	1 km
N_66	NationalAtlas	USEPA	Nationwide	Forest Fragmentation Causes	1:2,000,000	Raster	540 m
N_67	NationalAtlas	USEPA	Nationwide	Forest Fragmentation Causes	1:2,000,000	Raster	270 m
N_68	NationalAtlas	USGS	Nationwide	Generalized Geologic Map	1:2,000,000	Vector	
N_69	NationalAtlas	USGS	Nationwide	Hydrologic Unit Boundaries	1:2,000,000	Vector	
N_70	NationalAtlas	USGS	Nationwide	Invasive Species_Zebra Mussels	1:2,000,000	Vector	
N_71	NationalAtlas	USGS	Nationwide	Land Cover Characteristics	1:2,000,000	Raster	
N_72	NationalAtlas	USGS	Nationwide	Land Cover Diversity	1:2,000,000	Raster	
N_73	NationalAtlas	USGS	Nationwide	Mineral Operations_Agriculture	1:2,000,000	Vector	
N_74	NationalAtlas	USGS	Nationwide	Mineral Operations_Construction	1:2,000,000	Vector	
N_75	NationalAtlas	USGS	Nationwide	Mineral Operations_Ferrous Metal Mines	1:2,000,000	Vector	
N_76	NationalAtlas	USGS	Nationwide	Mineral Operations_Ferrous Metals Processing Plants	1:2,000,000	Vector	
N_77	NationalAtlas	USGS	Nationwide	Mineral Operations_Miscellaneous Industrial	1:2,000,000	Vector	
N_78	NationalAtlas	USGS	Nationwide	Mineral Operations_Nonferrous Metal Mines	1:2,000,000	Vector	
N_79	NationalAtlas	USGS	Nationwide	Mineral Operations_Nonferrous Metal Processing Plants	1:2,000,000	Vector	
N_80	NationalAtlas	USGS	Nationwide	Mineral Operations_Refractory, Abrasive, and other Industrial	1:2,000,000	Vector	
N_81	NationalAtlas	USGS	Nationwide	Mineral Operations_Sand and Gravel	1:2,000,000	Vector	
N_82	NationalAtlas	USGS	Nationwide	Mineral Operations_Stone, Crushed	1:2,000,000	Vector	
N_83	NationalAtlas	USGS	Nationwide	NAWQA Surface-Water Sampling Sites	1:2,000,000	Vector	
N_84	NationalAtlas	USGS	Nationwide	North American Bat Ranges	1:2,000,000	Vector	
N_85	NationalAtlas	USGS	Nationwide	Parkways and Scenic Rivers	1:2,000,000	Vector	
N_86	NationalAtlas	USGS	Nationwide	Principal Aquifers	1:2,000,000	Vector	
N_87	NationalAtlas	USGS	Nationwide	Public Land Survey	1:2,000,000	Vector	
N_88	NationalAtlas	USGS	Nationwide	Railroads	1:2,000,000	Vector	
N_89	NationalAtlas	USGS	Nationwide	Realtime Streamflow Stations	1:2,000,000	Vector	
N_90	NationalAtlas	USGS	Nationwide	Roads	1:2,000,000	Vector	

Nationwide

ID	Available From	Originator/ Publisher	Location	Data	Scale	Structure	Resolution
N_91	NationalAtlas	USGS	Nationwide	Shaded Relief of North America	1:2,000,000	Raster	
N_92	NationalAtlas	USGS	Nationwide	States	1:2,000,000	Vector	
N_93	NationalAtlas	USGS	Nationwide	Streams and Waterbodies	1:2,000,000	Vector	
N_94	NationalAtlas	USGS	Nationwide	Wilderness Areas	1:2,000,000	Vector	
N_95	NationalAtlas	USGS	Nationwide	Amphibian Distributions			
N_96	NationalAtlas	USGS	Nationwide	Butterflies			
N_97	NationalAtlas	USDA/NRCS	Nationwide	Invasive Species_Chinese Privet			
N_98	NationalAtlas	USDA/NRCS	Nationwide	Invasive Species_Tallowtree			
N_99	NationalAtlas	USDA/NRCS	Nationwide	Invasive Species_Common Gorse			
N_100	NationalAtlas	USDA/NRCS	Nationwide	Invasive Species_Leafy Spurge			
N_101	NationalAtlas	USDA/NRCS	Nationwide	Invasive Species_Purple Loosestrife			
N_102	NationalAtlas	USGS	Nationwide	Moths			
N_103	NationalAtlas	CDC	Nationwide	West Niles Virus_Human Cases			
N_104	NationalAtlas	CDC	Nationwide	West Niles Virus_Mosquito Surveillance			
N_105	NationalAtlas	CDC	Nationwide	West Niles Virus_Sentinel Flock Surveillance			
N_106	NationalAtlas	CDC	Nationwide	West Niles Virus_Veterinary Cases			
N_107	NationalAtlas	CDC	Nationwide	West Niles Virus_Wild Bird Cases			
N_108	NationalAtlas	CDC	Nationwide	West Niles Virus_Human Cases			
N_109	NationalAtlas	CDC	Nationwide	West Niles Virus_Mosquito Surveillance			
N_110	NationalAtlas	CDC	Nationwide	West Niles Virus_Sentinel Flock Surveillance			
N_111	NationalAtlas	CDC	Nationwide	West Niles Virus_Veterinary Cases			
N_112	NationalAtlas	CDC	Nationwide	West Niles Virus_Wild Bird Cases			
N_113	NationalAtlas	USGS NWHC	Nationwide	Wildlife Mortality_Frequency Data			
N_114	NationalAtlas	USGS NWHC	Nationwide	Wildlife Mortality_Botulism			
N_115	NationalAtlas	USGS NWHC	Nationwide	Wildlife Mortality_Cholera			
N_116	NationalAtlas	USGS NWHC	Nationwide	Wildlife Mortality_Lead Poisoning			
N_117	NationalAtlas	USGS NWHC	Nationwide	Wildlife Mortality_OP/CARB Poisoning			

NonGIS Digital Maps

ID	Available From	Originator/ Publisher	Location	Map	Scale	File Format
M_1	TGLO	TGLO	Cameron County	Land Use Maps for Management Area Counties		.jpg
M_2	TGLO	TGLO	State	Mean Annual Total Precipitation (inches) in Texas		.jpg
M_3	TGLO	TGLO	State	Major Surface Water Basins of Texas		.jpg
M_4	TGLO	TGLO	State	TNRCC Permit-by-Basin Approach to Wastewater Permitting		.jpg
M_5	TGLO	TGLO	State	SB 503 Priority Areas and Regional Offices		.jpg
M_6	TGLO	TGLO	State	NPDES Cities and Counties Located in the Coastal Watersheds		.jpg
M_7	TWDB	TWDB	State	Major Aquifers	1:250,000	.pdf and .jpg
M_8	TWDB	TWDB	State	Minor Aquifers	1:250,000	.pdf and .jpg
M_9	TWDB	TWDB	State	Major Surface/Groundwater Features	1:250,000 (counties and cities 1:100,000)	.pdf
M_10	TWDB	TWDB	State	Major Surface Water Features	Basins@1:500,000 Rivers@1:2,000,000 Reservoirs@1:250,000	.pdf and .jpg
M_11	TWDB	TWDB	State	Major Texas Rivers	1:250,000	.pdf and .jpg
M_12	TWDB	TWDB	State	Major River Basins in Texas	1:500,000	.pdf and .jpg
M_13	TWDB	TWDB	State	Major River Basins in Texas over DEM	1:500,000	.pdf
M_14	TWDB	TWDB	State	Wells Measured by TWDB and Cooperators		.pdf and .jpg
M_15	TWDB	TWDB	State	Wells Sampled by TWDB for Water Quality Analysis		.pdf and .jpg
M_16	TWDB	TWDB	State by Basin	Reservoir Basin Plates - Map Series		.pdf
M_17	TWDB	TWDB	State	Groundwater Management Areas		.pdf and .jpg
M_18	TWDB	TWDB	State	Groundwater Management Areas with Major Aquifers	Aquifers@1:250,00 GMA@1:100,000	.pdf and .jpg
M_19	TWDB	TWDB	State	Groundwater Management Areas with Minor Aquifers	Aquifers@1:250,00 GMA@1:100,000	.pdf and .jpg
M_20	TWDB	TWDB	State	Groundwater Conservation Districts		.pdf and .jpg
M_21	TWDB	TWDB	State	Groundwater Conservation Districts with Groundwater Management Areas		.pdf and .jpg
M_22	TWDB	TWDB	State	Groundwater Conservation Districts, Groundwater Management Areas, and Priority Groundwater Management Areas		.pdf and .jpg
M_23	TWDB	TWDB	State	Groundwater Conservation Districts and Major Aquifers and Priority Groundwater Management Areas		.pdf and .jpg
M_24	TWDB	TWDB	State	Regional Water Planning Groups		.pdf and .jpg
M_25	TWDB	TWDB	State	OPFCA Inspection and Field Support Services Offices		.pdf
M_26	TWDB	TWDB	State	Selected River Authorities and Special Law Districts		.pdf and .jpg
M_27	TWDB	TWDB	State	River Authorities and Special Law Districts		.pdf and .jpg

NonGIS Digital Maps

ID	Available From	Originator/ Publisher	Location	Map	Scale	File Format
M_28	TWDB	TWDB	State by region or Entire State	Regional Water Planning Group - Map Series		.pdf
M_29	TWDB	TWDB	State by county	Colonias - Map Series		.pdf

NonGIS Interactive Maps

ID	Available From	Originator/ Publisher	Location	Map
I_1	TWDB	TWDB	State	Office of Project Finance and Construction Assistance (OPFCA) Regions
I_2	TWDB	TWDB	State	Groundwater Conservation Districts
I_3	TWDB	TWDB	State	General Cartographic Base Mapper
I_4	TWDB	TWDB	State	Desalination Site Planning Tool

Databases

		Query info down to…				
ID	**Database**	**park**	**county**	**state**	**other**	**Who**
D_1	Breeding Bird Survey	no	no	yes	route	USGS
D_2	BEST_Large River Fish Health	no	no	no	station	USGS
D_3	BEST_CEE-TV	no	no	yes	HUC, City, Species	USGS
D_4	BEST_Biological and Ecotoxicological Characteristics of Terrestrial Vertebrate Species Residing in Estuaries	no	no	no	Gulf Coast	USGS
D_5	BEST_Species Decline	no	no	no	Gulf Coast	USGS
D_6	NAAMP	no	no	no	route	USGS
D_7	ARMI	no	no	no	no	USGS
D_8	Amphibian Counts Database	?	?	?	?	USGS
D_9	NARCAM	no	yes	no		USGS
D_10	NBII			yes	lat/long coordinates	USGS
D_11	Inventory and Monitoring on National Parks	yes				NPS
D_12	eBird	no	yes	yes	any location	
D_13	Christmas Bird Count	?	no	yes	count	Audubon
D_14	Christmas Bird Count	no	no	no	count	USGS
D_15	Project Feeder Watch	no	no	yes		Cornell Lab of Ornithology
D_16	Breeding Bird Census	?	?	?	?	USGS
D_17	Waterbird Monitoring Partnership	no	no	no	site_ID	USGS
D_18	Butterflies of North America	no	yes	yes		USGS
D_19	PLANTS Database	no	no	yes		NRCS/USDA
D_20	Chinese Privet	no	yes	yes		NRCS/USDA
D_21	National Atlas of the US					
D_22	Envirofacts_Air Releases (AIRS/AFS)		yes	yes	EPA region	EPA
D_23	Envirofacts_Multisystem Query		yes	yes	EPA region	EPA
D_24	Envirofacts_UV index		yes	yes	EPA region	EPA
D_25	Envirofacts_Toxic Release Inventory (TRI)		yes	yes	EPA region	EPA
D_26	Envirofacts_National Contaminant Occurrence Database (NCOD)		yes	yes	EPA region	EPA
D_27	Envirofacts_Environmental Radiation Ambient Monitoring System (ERAMS)		yes	yes	EPA region	EPA
D_28	Envirofacts_Water Discharge Permits (PCS)		yes	yes	EPA region	EPA
D_29	Nonindigenous Aquatic Species (NAS)	no	no	yes	HUC (2 and 6)	USGS
D_30	NWIS Web Site	no	yes	yes	HUC, Sampling Site	USGS
D_31	NatureServe Explorer	no	no	yes	plant/animal, status	NatureServe

Databases

		Query info down to…				
ID	**Database**	**park**	**county**	**state**	**other**	**Who**
D_32	MidWinter Bald Eagle Count	no	no	yes	route	
D_33	MAPS	no	no	yes	region, station	USGS
D_34	Mid-Winter Waterfowl Survey	no	no	yes	flyway, species, year	USFWS
D_35	Waterfowl Breeding Population and Habitat Survey	no	no	?	species, year, strata	USFWS
D_36	NBII Bird Conservation node					USGS
D_37	Migratory Bird Data Center					USFWS/USGS
D_38	Water Quality	yes	no	no		NPS
D_39	Air Quality	no	no	no	sampling station	TCEQ
D_40	Water Quality	no	no	no	sampling station	TCEQ
D_41	Toxic Release Inventory Program (TRI)					TNRCC
D_42	Water and Sediment Quality Sample Locations	no			state estuaries and tidal tributaries	TNRCC
D_43	EMAP	no				USEPA

Publications: Maps & Data

ID	Available From	Originator/ Publisher	Location	Publication
P_1	CKWRI	CKWRI	State	Caesar Kleberg Wildlife Research Institute
P_2	TWRI	TWRI	State	Various technical reports from 2003 back to 1964
P_3	UTCRWR	UTCRWR	State	UT Center for Research in Water Resources
P_4	USEPA	USEPA	National	Environmental Monitoring and Assessment Program (EMAP) Bibliographic Database
P_5	USEPA	USEPA	National	EPA Office of Wetlands, Oceans, and Watersheds
P_6	USGS	NWRC	National	National Wetlands Research Center
P_7	USGS	NWRC	National	National Wetlands Research Center
P_8	USACE	USACE	National	Wetlands Materials Index
P_9	NPSC	NPSC	National	Wetland Restoration Bibliography
P_10			National	Biodiversity and Biological Collections Web Server
P_11	USGS	USGS	National	Biological Resources Division - USGS
P_12	CMI	CMI	National	Fish and Wildlife Information Exchange
P_13	PWRC	PWRC	National	Patuxent Wildlife Research Center
P_14			National	Plants National Database

NatureBib Maps

NBIB_KEY_ID	Author	Year	Title
504511	Brown, L. F., Jr, , Brewton, J. L., , Evans, T. J., , McGowen, J. H., , White, W. A., , Groat, C. G., and Fisher, W. L.,	1980	Brownsville-Harlingen Area Texas Bureau of Economic Geology Environmental Geologic Atlas of the Texas Coastal Zone
48448	U.S. Department Of Housing And Urban Development, National Flood Insurance Program,	1978	Flood insurance rate map, City of Brownsville, Texas, Cameron County

Abbreviations	Description	Web Site
BEG	Bureau of Economic Geology (University of Texas, Austin)	http://www.beg.utexas.edu/
CCC	Texas Coastal Coordination Council	
CDC	Center for Disease Control	
CIR	Color Infra-Red	
CKWRI	Caesar Kleberg Wildlife Research Institute (Texas A&M)	
CMI	Conservation Management Unit (Virginia Tech)	
DLG	Digital Line Graph	
DOQQ	Digital Ortho Quarter Quadrangle	
DRG	Digital Raster Graphics	
ELLIS	Energy Land and Lease Inventory System	
EMAP	Environmental Monitoring and Assessment Program	
FEMA	Federal Emergency Management Agency	http://www.gismaps.fema.gov/rs.shtm
GBIS	Galveston Bay Information System	
GERG	Texas A&M University Geochemical and Environmental Research Group	
LAA	Landscape Analysis and Assessment	
LOSCO	Louisiana Oil Spill Coordinator's Office	
NED	National Elevation Data	
NGS	National Geodetic Survey	
NHD	National Hydrography Dataset	
NOAA	National Oceanic and Atmospheric Administration	
NOS	National Ocean Service	
NPS	National Park Service	
NPSC	Northern Prairie Science Center	
NRCS	Natural Resource Conservation Service	http://www.nrcs.usda.gov/technical/maps.html
NRI	Natural Resource Inventory	
NWHC	National Wildlife Health Center	
NWRC	National Wetlands Research Center	
PWRC	Patuxent Wildlife Research Center	
RRC	Railroad Commission of Texas	http://www.rrc.state.tx.us/other-information/automated/itssmap.html
TCEQ	Texas Commission on Environmental Quality	http://www.tceq.state.tx.us/
TCMS	Texas Centric Mapping System	
TCNRI	Texas Coastal Natural Resource Inventory	http://www.nri.state.tx.us/nri/
TGLO	Texas General Land Office	http://www.glo.state.tx.us/gisdata/gisdata.html
TLC	Texas Legislative Council	
TNRCC	Texas Natural Resource Conservation Commission	

Abbreviations	Description	Web Site
TNRIS	Texas Natural Resource Information System	http://www.tnris.state.tx.us/
TPWD	Texas Parks and Wildlife Department	
TSMS	Texas State Mapping System (State Plane Coordinate System)	
TWC	Texas Water Commission	
TWDB	Texas Water Development Board	http://www.twdb.state.tx.us/home/index.asp
TWRI	Texas Water Resources Institute	
TxDOT	Texas Department of Transportation	
USEPA	United States Environmental Protection Agency	http://www.epa.gov/mrlc/data.html
USFS	US Forest Service	http://www.srs.fs.usda.gov/4803/landscapes/index.html
USFW	United States Fish and Wildlife Service	
USGS	United States Geological Survey	http://mapping.usgs.gov/products.html#digital_data
USMMS	U.S. Minerals Management Service	
UTCRWR	UT Center for Research in Water Resources	
WRD	Water Resources Division	
NationalAtlas	National Atlas	http://nationalatlas.gov/atlasftp.html